Economic Impact Assessment for Ethanol Production and Use in Hawaii: An Interim Report

Hawaii Ethanol Workshop
sponsored by DOE and DBEDT
November 14, 2002

BBI International
Mark Yancey
602 Park Point Drive, Suite 250
Golden, Colorado 80401
(303) 526-5655 mark@bbiethanol.com

BBI INTERNATIONAL CONSULTING

BBI International

- Bryan & Bryan, Inc. founded in 1995 by Mike and Kathy Bryan
- 18 full-time employees
- 80+ years ethanol and biofuels experience
- Services:
  - Ethanol and Bioenergy Project Development
  - International Conferences and Workshops
  - Ethanol Producer Magazine
- An independent source of information and data for owners, lenders and policy makers

Presentation Overview

- Economic impact assessments
- Resources for ethanol production on Hawaii
- Ethanol market potential
- Ethanol production scenario
- Capital and operating cost estimates for ethanol production in Hawaii
- Economic impact results

Economic Impact Assessments

- Determine the impact of new economic activity on jobs, income, total spending and taxes for a specific region or area
- Determine the direct impacts and then use “multipliers” to determine indirect and induced impacts
- Not a feasibility study

Hawaii's Resources for Ethanol Production

- Ethanol is typically produce by fermentation of sugars by yeast
- All plants contain sugar, starch or cellulose – all can be used to make ethanol
- Hawaii has sugar and cellulose feedstocks and few starch crops
- MSW (garbage) can also be used

Feedstock Assessment

- There are only two crops grown in Hawaii at the scale required for production of ethanol:
  - Sugarcane and molasses
  - Pineapples (too expensive)
- Agricultural residues
- MSW and food waste
- Energy crops

Ethanol Potential

Feedstock Resource	Supply (dry tons)	Ethanol Yield (gal/ton)	Ethanol Potential (MMGY)
Sugar-based crops			
Raw sugar	300,000	150	45
Molasses	100,000	72	7
Food Waste	40,500	62	3
Organics in MSW	620,000	60	37
Lignocellulosics			
Pineapple residues	181,000	80	14
Sugarcane residues	535,000	75	40
State Total	**1,776,500**	**83**	**148**

Based on 2001 crop production data

Ethanol Market Potential

- Hawaii's transportation market is dependant on imported oil
- Present annual consumption of gasoline by the ground sector in Hawaii is on the order of 400 MMGY
- At 10% ethanol blend by volume = 40 million gallons of ethanol per year

Ethanol Production Scenario

- There are many possible scenarios for ethanol production in Hawaii
- After considering many different scenarios, BBI selected:
  - ❖15 MMGY on Oahu from MSW
  - ❖15 MMGY on Maui from Molasses
  - ❖10 MMGY on Kauai from Molasses

Oahu Ethanol Plant

- 15 million gallon per year capacity
- Assume that at this size the operation of the H-Power facility will not be affected
- Would utilize lignocellulosic biomass to ethanol technology (not commercial)
- An option for future consideration is to integrate an organic recycling program focused on generating biogas from food wastes to fuel the ethanol plant

Maui Ethanol Plant

- 15 million gallon per year capacity
- The Maui plant would utilize molasses from current sugar operations, supplemented with sugar from existing operations or from new sugarcane production

Kauai Ethanol Plant

- 15 million gallon per year capacity
- The Kauai plant would utilize molasses from current sugar operations, supplemented with sugar from existing operations or from new sugarcane production

Capital Cost Estimates

Ethanol Plant Site	Oahu	Maui	Kauai
Ethanol Production (Gal/Year)	**15,000,000**	**15,000,000**	**10,000,000**
Project Costs			
Ethanol Plant Cost per Gallon	$2.67	$1.94	$2.17
Engineering & Construction	$39,981,000	$29,143,000	$21,714,000
Inventory - Biomass	$136,000	$240,000	$160,000
Inventory - Chemicals/Denaturant	$66,000	$67,000	$45,000
Inventory - Ethanol & Lignin	$453,000	$435,000	$290,000
Spare Parts	$300,000	$300,000	$200,000
Startup Costs	$700,000	$700,000	$500,000
Land	$300,000	$300,000	$200,000
Administration Building & Furnishing	$200,000	$200,000	$200,000
Site Development Costs	$500,000	$500,000	$500,000
Tools and Laboratory Equipment	$200,000	$200,000	$200,000
Organizational Costs	$700,000	$700,000	$500,000
Capitalized Fees and Interest	$1,079,000	$787,000	$586,000
Working Capital	$400,000	$291,000	$217,000
Estimated Total Project Cost	**$45,015,000**	**$33,863,000**	**$25,312,000**

Operating Cost Estimates

Ethanol Plant Site	Oahu	Maui	Kauai
Production & Operating Expenses			
Feedstocks	$4,809,524	$8,487,395	$5,658,263
Purchased Cellulase Enzymes	$1,454,400	$0	$0
Other Chemicals	$1,115,329	$1,154,286	$769,524
Fuel Oil	$2,980,950	$2,833,333	$1,888,889
Electricity	$2,040,000	$1,165,714	$777,143
Denaturants	$655,714	$655,714	$437,143
Other costs	$484,757	$196,856	$137,585
Direct Labor & Benefits	$1,059,537	$1,059,537	$753,729
Total Production Costs	$14,600,211	$15,552,836	$10,422,275
Administrative Expenses	$2,777,196	$2,387,153	$1,910,661
Principal & Interest - Debt	$4,044,757	$3,010,711	$2,259,877
Annual Operating Expense	**$21,422,164**	**$20,950,700**	**$14,592,813**
Number of Employees	**31**	**31**	**22**

Economic Impacts

- The expenditures of the ethanol plants will become the income of other businesses or individuals, which in turn is re-spent in the economy to provide income for others
- The initial economic activity has a multiplier effect that ripples through the economy
- Economic impact analysis is an analytical method that provides a measure of the economic effects of an activity within a specified region

Economic Impact Results

Construction Phase Impacts	Oahu	Maui	Kauai
Ethanol Plant Capital Cost (millions)	$45.0	$33.9	$25.3
Final Demand Impact (millions)	$109.2	$82.2	$61.4
Earnings Impact (millions)	$35.5	$26.7	$19.9
Employment Impacts (indirect jobs)	1,108	833	623

Operations Phase Impacts	Oahu	Maui	Kauai
Operating Expenditures (millions)	$21.3	$20.8	$14.5
Final Demand Impact (millions)	$42.0	$41.1	$28.6
Earnings Impact (millions)	$7.5	$7.3	$5.1
Employment Impacts (direct jobs)	31	31	22
Employment Impacts (indirect jobs)	226	221	154
Total Jobs	257	252	176

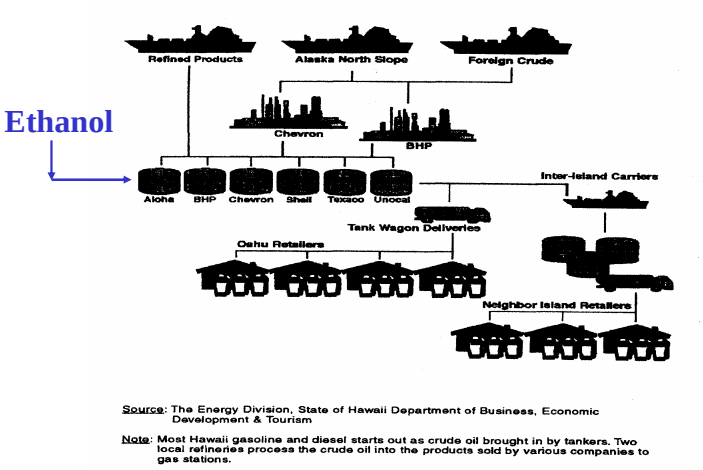
Tax Impacts

Impact of State Producer Payment	Oahu	Maui	Kauai
Ethanol Plant Average Pre-Tax Income (millions)	$3.6	$4.1	$2.0
Hawaii & Federal Corporate Income Tax Revenu	$1.5	$1.7	$0.8
Hawaii Personal Income Tax on Earnings	$0.6	$0.6	$0.4
Total Tax Revenue (millions)	$2.1	$2.3	$1.3
State Producer Payment (millions)	$4.2	$4.2	$2.7
Annual Return to State (millions)	($2.1)	($1.9)	($1.4)

Impacts to Fuel Refining and Distribution Systems

- Dr. Joseph Masin conducted a study to determine the capital and operating cost impacts of blending fuel grade ethanol with gasoline in Hawaii
- Ethanol is assumed to be manufactured in Hawaii and blended with gasoline at 10% by volume

Hawaii's Gasoline Distribution System



Source: The Energy Division, State of Hawaii Department of Business, Economic Development & Tourism

Note: Most Hawaii gasoline and diesel starts out as crude oil brought in by tankers. Two local refineries process the crude oil into the products sold by various companies to gas stations.

Ethanol Blending

- Petroleum refiners will need to remove light gasoline components, like butanes and pentanes, from current blend recipes in order to accommodate the relatively high vapor pressure that results when ethanol is blended with gasoline at 5 to 10 percent by volume ethanol
- This may require modification of distillation and storage facilities, as well as finding markets for the removed components

Ethanol Blending Scenarios

Component	Volume 10^6 gal/yr	RVP psi	Octane RM/2	Weight 10^3 T/yr	LHV 10^9Btu/yr
Case 1	Existing Blend				
Butane	24	51.5	92	58	-2295
LVN	16	12.0	61	43	-1685
Other Gasoline Base	360	8.8	89	1206	-45828
Total	400	11.5	88.2	1308	-49807
Content per gallon (# or Btu)				6.54	-124518
Case 2	Add ethanol, waive RVP limit				
Ethanol	44	18.0	113	145	-3454
Butane	24	51.5	92	58	-2295
LVN	14	12.0	61	38	-1464
Other Gasoline Base	360	8.8	89	1206	-45828
Total	442	12.1	90.8	1447	-53041
Content per gallon (# or Btu)				6.55	-120027
Case 3	Add ethanol, keep RVP limit				
Ethanol	43	18.0	113	141	-3375
Butane	18	51.5	92	43	-1675
LVN	14	12.0	61	38	-1469
Other Gasoline Base	360	8.8	89	1206	-45828
Total	434	11.5	90.7	1428	-52348
Content per gallon (# or Btu)				6.57	-120485
Case 4	Replace lights with Ethanol, keep RVP				
Ethanol	41	18.0	113	135	-3211
Butane	8	51.5	92	19	-765
LVN	0	12.0	61	0	0
Other Gasoline Base	360	8.8	89	1206	-45828
Total	409	10.6	91.6	1360	-49803
Content per gallon (# or Btu)				6.65	-121799

Summary of Refinery and Fuel Distribution Impacts

Ethanol Blending	Case 2	Case 3	Case 4
Description	Waive RVP Limit	Keep RVP Limit	Replace Lights with Ethanol
Vapor Pressure (psi) *	12.1	11.5	10.6
Refiner's Capital Costs ($MM)	$3.00	$4.30	$5.70
Additional Labor (FTE)	8.90	8.80	8.60
Net Refiner Revenue ($/gal)	$0.07	$0.06	$0.02
Net Decrease in Energy ($/gal)	($0.05)	($0.05)	($0.03)
Net Savings with Ethanol ($/gal)	$0.02	$0.01	($0.01)

* Vapor pressure limit for gasoline in Hawaii is 11.5 psi

Conclusions for Ethanol Production Impacts

- These results are preliminary! Refinery side impacts are not incorporated
- Sugar and starch feedstocks are in short supply due to declining sugarcane acreage
- Lignocellulosic feedstocks are plentiful, but the corresponding ethanol technology is not yet commercial
- The potential ethanol market on Hawaii is 40 MMGY and growing

Conclusions

- Ethanol production brings significant positive economic impacts:
  - Total constructions costs = $104 million
  - The resulting total economic impact during construction is estimated to be $253 million
  - Total jobs created during construction are approximately 2,564 with an increase in personal income of $82 million
  - Combined annual operating costs = $57 MM
  - Creating $112 million in total annual economic activity and 686 new jobs